University of Saskatc
College of Enginee
EE 444.3: Electrical Ma
Midterm Examina

Instructor:	Dr. N. Kar	October 29, 2002
Time:	1 hour & 20 min.	
Note:	One sheet of handwritten formulas permitted	

Marks

20 1. (a) Calculate the force produced on the moving part of the shown unipivot relay mechanism (Fig. 1) where the motion may be assumed to be linear. The coil has 1000 turns and the DC current flowing in it is 1.0 A. Neglect fringing and leakage flux, and assume that all the energy is stored in the air-gap.
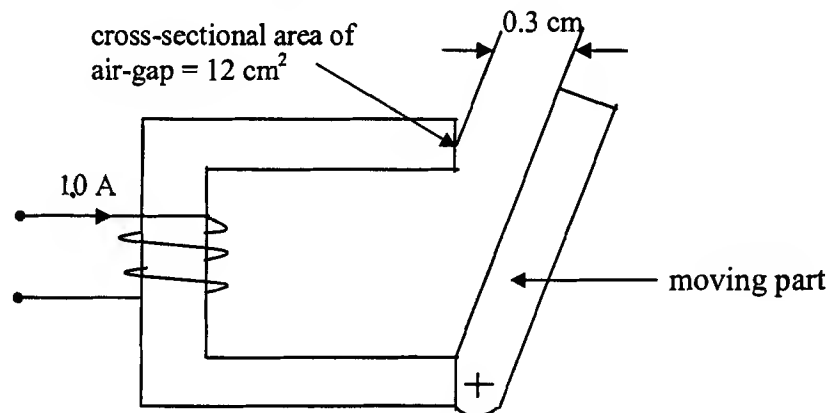
Fig. 1. Relay mechanism.

(b) If the following factors:

  (i) the leakage flux
  (ii) the fringing effect
  (iii) the iron path of the magnetic path

are not neglected, describe using literature the effect of these factors on the value of the force calculated in (a).

(c) Answer whether the following statements are true or false.

  (i) If the magnetization curve of an electromagnetic device is nonlinear, the energy stored in the magnetic field is smaller than the coenergy.
  (ii) The synchronous reactance of a synchronous generator is larger than its leakage reactance.
  (iii) A synchronous generator operating at lagging PF (power factor) is underexcited.

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2. A 480 V, 60 Hz, Δ-connected, 4-pole synchronous generator has the open-circuit characteristic shown in Fig. 2. This generator has a synchronous reactance of 0.11 Ω and an armature resistance of 0.016 Ω. At full-load, the machine supplies 1200 A at 0.8 PF lagging. Under full-load conditions, the friction and windage losses are 40 kW, and the core losses are 30 kW. Ignore any field circuit losses.

(a) What is the speed of rotation of this generator?

(b) How much field current must be supplied to the generator to make the terminal voltage 480 V at no load?

(c) If the generator is now connected to a load and the load draws 1200 A at 0.8 PF lagging, how much field current will be required to keep the terminal voltage equal to 480 V. Draw the phasor diagram.

(d) How much power is the generator now supplying? How much power is supplied to the generator by the prime-mover? What is the machine's overall efficiency?

(e) If the generator's load were suddenly disconnected from the line, what would happen to its terminal voltage?

(f) Finally, suppose the generator is connected to a load drawing 1200 A at 0.8 PF leading. Draw the phasor diagram. How much field current would be required to keep the terminal voltage at 480 V?
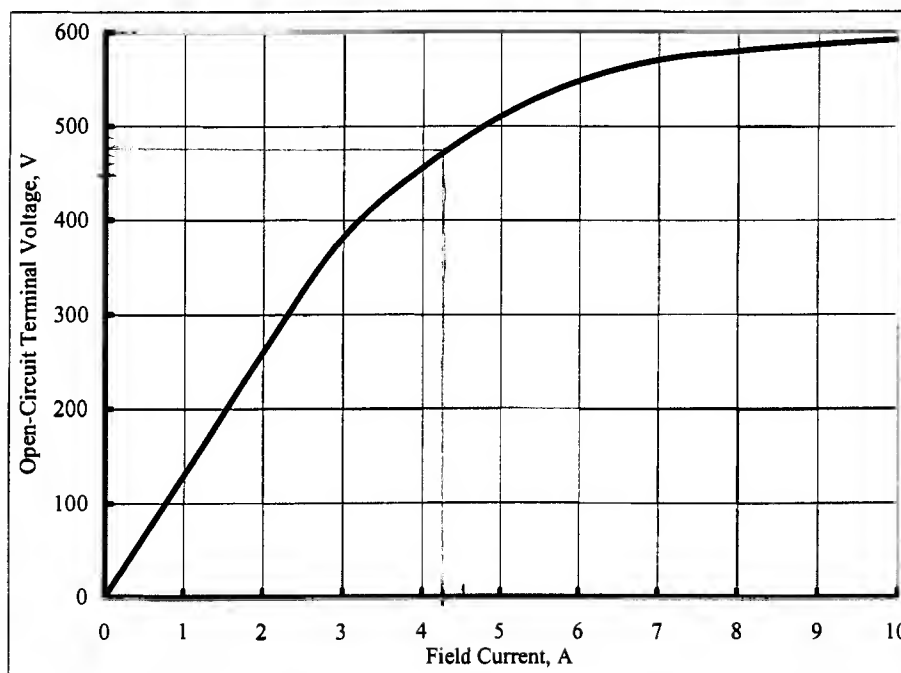

Fig. 2. Open-circuit characteristic of the generator in Question 2.

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